82d Congress, 2d Session - - - - - House Document No. 395

PEE DEE RIVER WATERSHED IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA

LETTER

FROM

ACTING SECRETARY, DEPARTMENT OF AGRICULTURE

TRANSMITTING

A SURVEY REPORT DATED MAY 1950, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, OF THE PEE DEE RIVER WATERSHED IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA, MADE UNDER THE PROVISIONS OF THE FLOOD CONTROL ACT APPROVED JUNE 22, 1936, AS AMENDED AND SUPPLEMENTED

MARCH 20, 1952.—Referred to the Committee on Public Works and ordered to be printed with illustrations.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1952

96902

LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, March 10, 1952.

The SPEAKER,
House of Representatives.

DEAR MR. SPEAKER: I am submitting herewith a survey report dated May 1950, together with accompanying papers and illustrations, of the Pee Dee River watershed in Virginia, North Carolina, and South Carolina, made under the provisions of the Flood Control Act approved June 22, 1936, as amended and supplemented.

I recommend that the Secretary of Agriculture be authorized to carry out the program of runoff and waterflow retardation and soil erosion prevention proposed in this report.

Enclosed are comments received from Governors of the concerned States and interested Federal agencies.

The Bureau of the Budget, in its letter of February 25, 1952, advises that there is no objection to the submission of this report to the Congress. The Bureau further advises that it is in agreement with the objective contemplated in the report of carrying out measures designed to retard floods and prevent soil erosion, and that this objective is particularly desirable from the point of view of coordination of upstream measures with the flood control programs of the Corps of Engineers. A copy of the letter from the Bureau of the Budget is enclosed.

Sincerely,

K. T. HUTCHINSON,
Acting Secretary.

PEE DEE RIVER WATERSHED IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA

LETTER FROM THE BUREAU OF THE BUDGET TO THE SECRETARY OF AGRICULTURE

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., February 25, 1952.

The honorable the SECRETARY OF AGRICULTURE.

MY DEAR MR. SECRETARY: This will acknowledge receipt of Acting Budget Officer John Wells' letter of January 22, 1951, requesting advice as to the relationship to the President's program of the proposals contained in your Department's report, dated May 1950, entitled "Interim Survey Report, Pee Dee River watershed, Virginia, North Carolina, South Carolina."

Floodwater and sediment damages occurring in the Pee Dee River watershed are estimated to average $2,193,000 annually. The principal losses, estimated to average $1,437,000 annually, are caused by flooding of agricultural crops. Floods also cause damages to public roads and railroads, while sediment damages occur to water supplies, drainage channels, recreation, aquatic life, and public health.

It is proposed to alleviate these damages and to realize extensive associated benefits by installing a number of interrelated and interdependent soil and water conservation and control measures or groups of measures, mostly vegetative in character, during a 20-year period. These measures, applied in proper combination with other soil and water conservation practices and measures, would constitute a basic system of soil and water conservation in accordance with needs and capabilities of the land in the Pee Dee River watershed. Educational assistance and technical services are also recommended as a part of the proposed program.

The estimated total cost of the recommended program, based on 1946 prices and an intermediate level of employment, is $20,660,000. The Federal Government would be expected to expend $13,638,000 of the total cost; non-Federal public agencies would be required to pay out $1,514,000; and private interests would contribute $5,508,000 or its equivalent in labor, materials, equipment, land easements, rights-of-way, and other assistance in lieu of cash payments. Operation and maintenance of the recommended works of improvement are estimated to cost $1,118,700 annually, of which $273,800 would be paid by the Federal Government, and $844,900 or its equivalent would be borne by the local people.

It is estimated that the recommended watershed program, if installed as planned and maintained adequately, will yield average annual benefits evaluated at $11,075,000. These benefits are grouped under two categories—flood-control benefits, amounting to $1,542,000; and

"associated benefits," totaling $9,533,000. The flood-control benefits, which are derived chiefly from channel improvement and streambank stabilization, consist of floodwater-damage reductions to crops and pasture and to public roads and railroads, and sediment-damage reductions resulting in a lowering of the cost of maintaining reservoirs and treating public-water supplies, and seem to be incidental to the over-all conservation benefits of the recommended program. It is noted that the average annual floodwater and sediment damage of $2,193,000 would be reduced by $1,542,000, or about 70 percent. The conservation benefits of over $9,000,000 would result mainly from the provision of farm waterways, terraces, pasture development, and other conservation measures.

The total average annual costs are estimated at $1,717,900. Since prices are expected to vary during the 20-year installation period, both benefits and costs were adjusted to anticipate future price levels by applying indexes provided by the Bureau of Agricultural Economics. The effect of this adjustment or alternate evaluation is to reduce monetary values of both benefits and costs. Thus, the average annual benefits are adjusted to $8,237,900 and the costs on the same basis to $1,484,000. This adjustment results in a revised benefit-cost ratio of 5.55 to 1.0 for the recommended program. If further consideration is given to the fact that some benefits from the land treatment measures will be delayed 5 to 40 years, the ratio of total benefits to total costs for all measures becomes 3.66 to 1.0.

The report has been reviewed by the Governors of North Carolina, South Carolina, and Virginia, and also by the several concerned Federal agencies in accordance with policies and procedures for distribution and coordination of reports as adopted by the Federal Inter-Agency River Basin Committee. The views expressed are generally favorable to the proposed program, with suggestions limited to considerations that could be resolved cooperatively by the concerned agencies or local interests during the periods of planning and installing the watershed works of improvement.

The work envisioned in the report constitutes predominantly open land, farm, and woodland improvement measures which will produce very high conservation benefits, accruing mainly to landowners and farm operators in the form of increased returns due to improved practices. The program recommended appears to be largely an intensification, acceleration, and adaptation of soil and water conservation activities already in progress under going programs of the Department of Agriculture. These include such programs as the conservation and use program, authorized by the Soil Conservation and Domestic Allotment Act, approved February 29, 1936, as amended; the Soil Conservation Service's program of assistance to districts and other cooperators, authorized by the act of April 27, 1935; and State and private forestry cooperation, pursuant to the act of August 25, 1950, sections 1 through 5 of the act of June 7, 1924, and acts supplementary thereto.

The Bureau of the Budget is in agreement with the objective contemplated in the report of accelerating land-treatment measures and installing structural measures designed to retard floods and prevent soil erosion. This objective is particularly desirable from the point of view of coordination of upstream measures with the flood control programs of the Corps of Engineers.

The measures contemplated to implement the proposed program might be grouped into two broad categories—land treatment measures and structural measures. The Bureau of the Budget is of the opinion that installation of the structural measures (shown in table 2, p. 16 of the report as "Subwatershed Waterways," "Gully Stabilization and Sediment Control," "Erosion Control along Roads and Railroads," "Water Disposal from Hill Lands," and "Tributary Channel Improvement and Stream-bank Stabilization") should properly be authorized under the Flood Control Act, as amended and supplemented. The Bureau also believes that the land-treatment measures set forth in the report, since they are largely an acceleration of existing programs of the Department of Agriculture, should be financed under appropriations other than that for the Flood Control Act. This would avoid confusion in the presentation of the Department's budgetary program, since many of the current land treatment programs of the Department have the objective of runoff and water-flow retardation and the prevention of soil erosion. To the extent that the acceleration of land-treatment measures under existing authorities is not possible, we urge that adequate authorities for such acceleration be sought through amendment of those basic authorities.

Your staff, on the other hand, believes that the Department cannot properly meet its responsibilities under the Flood Control Act unless the full program envisioned in the report is authorized under that act. Your representatives, however, agreed that appropriations for land treatment phases implementing the program recommended in the report, upon approval by the Congress generally on the basis as submitted, would be sought as additions to going program appropriations of the agencies carrying on the work. Funds for structural works or measures would still be requested under the appropriation "Flood control." The total obligations for land treatment and structural measures in each authorized flood-control-project area could, of course, be shown in a summary table to be presented in the program and performance section of the annual budget document.

Subject to the above understanding as to the method of presenting the budget for flood-control programs, there would be no objection to the submission of the proposed Pee Dee River watershed flood-control-survey report to the Congress. In the event the report or any modification thereof is approved by the Congress, submission of requests for appropriations must be justified in accordance with the policy set forth in the President's letter of July 21, 1950, which directed that all civil public works be considered with the objective, as far as practicable, of deferring, curtailing, or slowing down those projects which do not directly contribute to national defense or to civilian requirements essential to the changed international situation, or as may later be modified.

In submitting the Department's report to the Congress, it will be appreciated if you include a copy of this letter.

Sincerely yours,

ELMER B. STAATS, *Assistant Director.*

LETTER FROM THE CHIEF OF ENGINEERS TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., January 16, 1951.

The honorable the SECRETARY OF AGRICULTURE.

DEAR MR. SECRETARY: Reference is made to letter of recent date from the Assistant Secretary of Agriculture forwarding for information and comment copies of the report by the Department of Agriculture on the Pee Dee watershed, Virginia, North Carolina, and South Carolina.

The report recommends that the Federal Government undertake an extensive program of watershed treatment, in addition to existing programs, for reducing flood runoff and sediment control, and conservation of soil by means of minor watershed improvements, torrent control, gully stabilization, sediment control, erosion control along roads and railroads, terracing, field borders, farm waterways, water disposal from hill lands, woodland improvement and management, tree planting, adequate fire control, land acquisition, tributary channel improvement, and other soil conservation practices. The total first cost of the program, including some maintenance during the 20-year installation period, is estimated at $20,660,000, based on 1946 price levels, of which $12,638,000 would be Federal, and $7,022,000 would be non-Federal. The estimated average annual cost of operation and maintenance is $1,118,700.

The report indicates that the estimated total average annual benefits from the program would be $11,075,000, of which $1,542,000, or 14 percent, would be flood control, and $9,533,000, or 86 percent, would be associated benefits from erosion control, conservation farming, and woodland management. The report states that these estimates include $27,000 annual benefits which would also be obtained by the flood-control reservoirs authorized for construction by the Corps of Engineers. The computed ratio of total benefits to total costs at adjusted price levels is stated to be 5.6 to 1 before discounting deferred benefits from land-treatment measures, and 3.66 to 1 after discounting such deferred benefits.

I have no specific comments concerning the watershed-management program, which constitutes the major portion of your recommended plan of improvement. It is noted, however, that the subwatershed-waterways portion of the program may incorporate floodwater storage in some of the structures. The number, location, physical features, design capacity, and estimated costs of these storage projects are not presented in the report, and it is, therefore, impracticable to comment thereon in detail at this time. However, when detailed planning is undertaken, careful engineering studies should be made to determine if the flood-control features are adequate for the intended purpose. It is also noted that the recommendations in the report include provision of authority for the Secretary of Agriculture to make such modifications or substitutions of the measures described as may be deemed advisable due to changed physical or economic conditions or improved techniques, whenever he determines that such action will be in furtherance of the objective of the recommended program.

The plans and estimates presented are based on extension of studies and estimates on sample areas to the entire basin under consideration.

While this procedure may be adequate for setting up a general plan of improvement of this kind, it appears from our experience that more detailed engineering studies will be required for an accurate determination of costs, locations, and probable effects of flood-storage structures, as well as to insure provision of reasonably safe and adequate projects. Careful study is believed particularly desirable of the possible failure of such structures if they should be designed upon a calculated-risk basis for a fairly frequent design flood. These studies would, of course, be necessary before construction is undertaken, and the necessity for such analyses and their possible effects upon the economics of the program, as well as for careful coordination of flood control and watershed management plans, should be recognized.

The opportunity to review your report is appreciated.

Sincerely yours,

LEWIS A. PICK,
Major General,
Chief of Engineers.

LETTER FROM THE DIRECTOR OF THE OFFICE OF INDUSTRY AND COMMERCE, BUREAU OF FOREIGN AND DOMESTIC COMMERCE, TO THE ASSISTANT SECRETARY OF AGRICULTURE

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington 25, D. C., November 8, 1950.

Hon. K. T. HUTCHINSON,
Assistant Secretary of Agriculture,
Washington, D. C.

DEAR MR. SECRETARY: We have reviewed the interim survey report on the Pee Dee River watershed in Virginia, North Carolina, and South Carolina, which you kindly submitted to us. In general, the program proposed appears sound from a benefits and costs point of view, and we have no specific comments to make on it.

Sincerely,

H. B. MCCOY, *Director.*

LETTER FROM THE GOVERNOR OF SOUTH CAROLINA TO THE ASSISTANT SECRETARY OF AGRICULTURE

STATE OF SOUTH CAROLINA,
OFFICE OF THE GOVERNOR,
Columbia, November 3, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: In response to your letter of October 31, in which you refer to your communication of July 25 and the Department of Agriculture's survey report on the Pee Dee watershed in Virginia, North Carolina, and South Carolina, I wish to advise that in view of the fact that practically none of the area covered by the survey mentioned is in South Carolina, I do not have any comments to make regarding the recommendations contained in the report.

With kindest regards and best wishes,

Very truly,

J. STROM THURMOND, *Governor.*

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LETTER FROM THE GOVERNOR OF VIRGINIA TO THE ASSISTANT SECRETARY OF AGRICULTURE

COMMONWEALTH OF VIRGINIA,
GOVERNOR'S OFFICE,
Richmond, November 3, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: Reference is made to your letters of July 25, 1950, and October 31, 1950, in which you request comments on your Department's proposed report on the watershed of the Pee Dee River.

Only a small portion of the Pee Dee watershed lies in Virginia, and the benefits accruing from an intensified and accelerated program of waterflow retardation and soil erosion prevention would be relatively small.

Should all or parts of the report be considered favorably by the Bureau of the Budget and the Congress, it is hoped that the final program will (1) avoid Federal competition with soil conservation programs supervised by State agencies; (2) insure that Federal activities will not duplicate State activities; and (3) keep to a minimum the amount of Federal funds expended.

It will be appreciated if you will keep me informed concerning actions which are taken on the report.

Sincerely yours,

JOHN S. BATTLE, *Governor.*

LETTER FROM THE ASSISTANT SECRETARY OF THE INTERIOR TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., November 3, 1950.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture,
Washington 25, D. C.

MY DEAR MR. SECRETARY: In accordance with Federal Intera-Aency River Basin procedures, Assistant Secretary Hutchinson transmitted by letter dated July 25, 1950, for the information and comments of the Department, copies of the Department of Agriculture's interim survey report on the Pee Dee River watershed in Virginia, North Carolina, and South Carolina.

The report recommends a program of runoff and water-flow retardation and soil-erosion prevention in the Pee Dee River watershed during a 20-year period at an estimated cost of $13,638,000 to the Federal Government and $7,022,000, or its equivalent, to local interests, making an estimated total cost of $20,660,000 for installing the program. The program will be operated and maintained at an estimated annual cost of $273,800 to the Federal Government and $844,900, or its equivalent, to local interests. It is estimated that the total average annual benefit will be about $11,000,000, of which over $1,500,000 results from reduction in floodwater damage and $9,500,000 from

associated benefits, including farm erosion control, conservation farming, and decreased maintenance costs on public roads and highways.

The program includes construction of subwatershed waterways, farm waterways, terraces and field diversions, gully stabilization, establishment of perennial vegetation, pasture development, adequate fire control, land acquisition, and other soil and water conservation practices and measures in accordance with the needs and capabilities of the land of the watershed.

The development of details of land-use modification programs on sound lines requires many basic data and much research in many fields, including geology and hydrology. Similarly, adequate geologic and topographic mapping are essential.

The land-water relationship evidently enters very dominantly into the planning and evaluation of the proposals in this report, and in that connection systematic studies of stream flow, ground water, sediment loads and erosion are necessary for sound implementation and evaluation of the program. However, review of this report indicates that the analyses of the anticipated beneficial effects of the recommended program upon stream flow are based upon (1) inadequate data and (2) lack of research to demonstrate the effects of changes in land use upon stream flow. In this connection, it is noted that the report contains no hydrologic data later than 1941, indicating perhaps that the analyses are now some years old.

Deficiencies in basic data and research make evaluations of the benefits ascribed to the proposals for runoff and water-flow retardation subject to question. Moreover, it is noted that only about 14 percent of the total benefits shown are for flood control even though the introductory parts of the report describe flood damage as a major problem in the basin.

In the preparation of reports involving broad phases of hydrology, it is suggested that needs for basic data and proposed techniques of the analyses be discussed by research groups in the Department of Agriculture and in this Department, particularly in the Geological Survey. The Geological Survey would be pleased to cooperate with the Department of Agriculture in setting up and carrying out investigations to supply the basic facts needed to put these programs on a sounder basis.

In the review of the report at regional level, field representatives of the Fish and Wildlife Service have commented favorably on the report. The Department also feels that the over-all plan as proposed for this watershed would be of general benefit to these resources. However, it is difficult to analyze the report with regard to effects on fish and wildlife resources since specific areas are not considered.

Measures primarily designed for waterflow retardation and soil-erosion prevention through establishment of perennial vegetation, subwatershed water-disposal system, farm waterways, erosion-control along roads and railroads, and similar work should be beneficial in that food and cover plants for wildlife would be established in the badly eroded areas. Expansion in establishment of field borders as recommended in the program would further enhance wildlife habitat, as would woodland improvement and management, tree planting, and adequate fire control in woodland areas. Concurrent reduction in sediment movement, channel scour, and bank cutting would improve conditions for fishery resources downstream. The 3,279 farm

ponds which were planned for the next 20 years will substantially contribute to the fishery resources of the watershed, providing they are managed in part for fish production. Maximum benefits to fish and wildlife through the combined effects of these improvements can be obtained only if fish and wildlife management can be made a part of the land-management program for the watershed.

It is our understanding from correspondence received from the regional office of the Soil Conservation Service that "water-disposal from hill lands" is intended to mean the orderly disposal of water from hillsides through well-defined ditches or channels across bottomlands and into the main streams so as to prevent the flooding of valuable croplands in the flood plains. Furthermore, it is our understanding that no drainage of the bottomlands by the ditches or channels which cross them will result and that subsequent clearing of swamplands is not anticipated. It is also understood that the stream-channel improvement proposed will not result in the drainage of swamps, and is merely intended to regulate the flow of these streams so as to prevent the flooding of valuable croplands in the flood plains. In view of this, and the possible compensatory beneficial effects of sediment control on the fisheries that may be anticipated, there should be no significant harmful effects on fish and wildlife resources of the area.

The Department recommends that every effort be made to encourage land owners to recognize fish and wildlife production opportunities in farm planning, and to coordinate the long-range program of the Department with the State agencies responsible for fish and wildlife conservation and management. Participation by the States in the over-all program for the watershed may be assisted substantially by the Federal aid to fisheries and wildlife restoration programs administered by the Fish and Wildlife Service. At such time as the program is authorized the Fish and Wildlife Service will appreciate the opportunity to cooperate with the Department and the States concerned in effectuating a program to obtain the maximum benefits to fish and wildlife resources.

The program proposed will benefit departmental interests within the basin, especially if opportunity is afforded the Fish and Wildlife Service in cooperation with the States concerned to participate should the program be authorized. Further, the Geological Survey of this Department would welcome cooperation with the Department of Agriculture in setting up and carrying out investigations to supply basic facts needed to put programs involving broad phases of hydrology, such as presented in your report, on a sounder basis.

Opportunity to review the report is appreciated.

Sincerely yours,

WILLIAM E. WARNE,
Assistant Secretary of the Interior.

LETTER FROM THE ASSISTANT SURGEON GENERAL TO THE ASSISTANT SECRETARY OF AGRICULTURE

FEDERAL SECURITY AGENCY,
PUBLIC HEALTH SERVICE,
Washington 25, D. C., October 26, 1950.

MR. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Office of the Secretary, Washington 25, D. C.

DEAR MR. HUTCHINSON: In accordance with the policies and procedures of the Federal Inter-Agency River Basin Committee, we have reviewed the report furnished by your Department Pee Dee River watershed, Virginia, North Carolina, South Carolina, May 1950 (report of appendixes A, B, C, D, and E).

We are not able to submit a memorandum because of time limitations. Written reviews will be prepared for all future reports, however.

Clearance is hereby given this report and a copy of this letter is being sent to the secretary of the Federal Inter-Agency River Basin Committee for his information.

Sincerely yours,

M. D. HOLLIS,
Assistant Surgeon General,
Associate Chief, Bureau of State Services.

LETTER FROM THE ACTING CHAIRMAN OF THE FEDERAL POWER COMMISSION TO THE SECRETARY OF AGRICULTURE

FEDERAL POWER COMMISSION,
Washington 25, September 20, 1950.

Subject: Pee Dee River watershed, Virginia, North Carolina, and South Carolina.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture,
Washington 25, D. C.

DEAR MR. SECRETARY: The comments herein with respect to your Department's interim survey report on the Pee Dee River watershed in Virginia, North Carolina, and South Carolina, dated May 1950, are transmitted in response to the Assistant Secretary's letter of July 25, 1950. The transmittal of these comments is in accordance with established procedures of the Federal Inter-Agency River Basin Committee.

The interim survey report recommends a program for runoff and water-flow retardation and soil-erosion prevention in the upper Pee Dee and Yadkin River Basins, consisting of various land-treatment measures, channel improvements, small earth-fill dams, and other similar measures. The program would be developed during a 20-year period at an estimated total cost of $20,660,000. Of this amount, it is estimated that the Federal Government would expend $13,638,000; non-Federal public agencies, $1,514,000; and private interests, $5,508,000. The estimated annual benefits amount to $11,075,000 and the estimated ratio of benefits to costs is 5.6.

The Commission staff has reviewed the report of your Department primarily with a view to determining whether the proposed plan of improvement would affect existing or potential hydroelectric-power plants or offer any possibilities for hydroelectric-power development. There are five existing hydroelectric-power developments of importance in the Yadkin-Pee Dee River Basin, having an aggregate installation of about 221,000 kilowatts, including industrial power

plants. The aggregate installed capacity at the undeveloped water-power projects in the basin is presently estimated to be about 345,000 kilowatts.

The effect of the recommended program on existing and potential hydroelectric developments would be reflected in the modifications of the runoff and stream-flow characteristics, and in changes in the rate of silting of reservoirs. The staff points out that sufficient experimentation and research have not been accomplished to determine the extent to which the program would affect runoff and stream flows, particularly during normal and low-flow years. To the extent that the recommended program will reduce the silt carried by the streams and thus prolong the life of reservoirs, it will be beneficial to hydroelectric-power devlopment. However, for large reservoirs the effect of the land-conservation program would be small in monetary terms insofar as power-development projects are concerned, since these reservoirs would normally contain sufficient dead storage to permit large silt deposits without affecting the usable storage during the economic life of the projects.

The Commission appreciates the opportunity of reviewing and commenting on the report of your Department.

Sincerely yours,

THOMAS C. BUCHANAN,
Acting Chairman.

LETTER FROM THE GOVERNOR OF NORTH CAROLINA TO THE ASSISTANT SECRETARY OF AGRICULTURE

STATE OF NORTH CAROLINA,
GOVERNOR'S OFFICE,
Raleigh, August 8, 1950.

Hon. K. T. HUTCHINSON,
Assistant Secretary of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: Thank you very much for sending me an advance copy of the Department of Agriculture's survey report on the Pee Dee River watershed in Virginia, North Carolina, and South Carolina.

I have gone over this report with the Corps of Army Engineers and, as far as I am able to tell, the project is all right as far as this State is concerned.

Sincerely,

W. KERR SCOTT, *Governor.*

UNITED STATES DEPARTMENT OF AGRICULTURE

INTERIM SURVEY REPORT

PEE DEE RIVER WATERSHED

NORTH CAROLINA, SOUTH CAROLINA, AND VIRGINIA

Program for Runoff and Water-Flow Retardation and Soil Erosion Prevention

Pursuant to the Act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented

MAY 1950

CONTENTS

APPENDIXES

(These appendixes are not printed in this document.)

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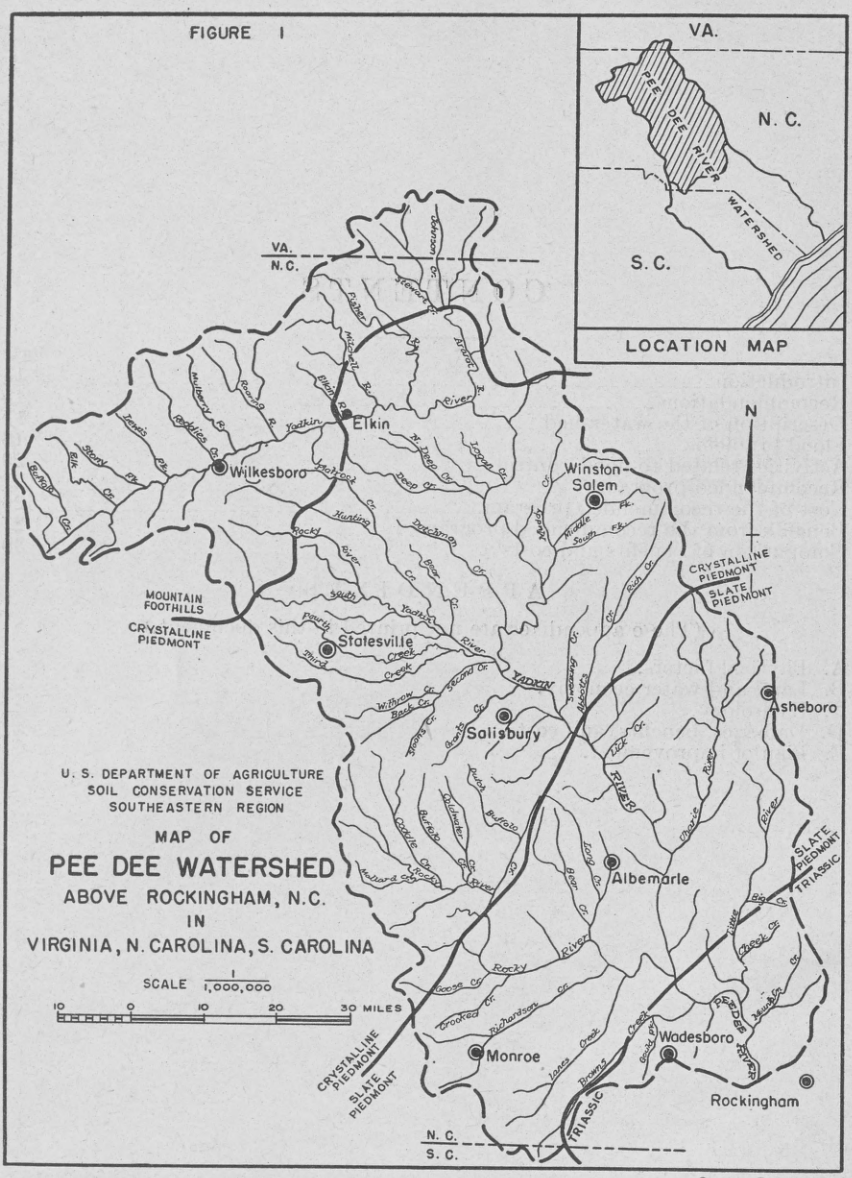
FIGURE 1
VA.
N. C.
S. C.
PEE DEE RIVER
WATERSHED
LOCATION MAP
VA.
N.C.
Elkin
Wilkesboro
Winston-Salem
Statesville
Salisbury
Albemarle
Asheboro
Monroe
Wadesboro
Rockingham
N
MOUNTAIN FOOTHILLS
CRYSTALLINE PIEDMONT
SLATE PIEDMONT
TRIASSIC
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTHEASTERN REGION
MAP OF
PEE DEE WATERSHED
ABOVE ROCKINGHAM, N.C.
IN
VIRGINIA, N. CAROLINA, S. CAROLINA
SCALE 1:1,000,000
10 0 10 20 30 MILES
N. C.
S. C.
2-L-5192-2C

PEE DEE RIVER WATERSHED IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA

Introduction

AUTHORITY

This interim report is submitted under the provisions of the act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented.

PURPOSE AND SCOPE OF REPORT

The purpose of this interim report is to outline a program of runoff and water-flow retardation and soil-erosion prevention for that part of the Pee Dee River watershed in North Carolina, Virginia, and South Carolina lying above the stream gage at United States Highway 74 bridge, 6 miles west of Rockingham, N. C. (hereinafter referred to as the Pee Dee River watershed); and to present recommendations for the installation and maintenance of the program, together with an analysis of the cost and benefit thereof. This area covers the upper portion of the watershed, comprising approximately 6,870 square miles, 98 percent of which is located in North Carolina and the remainder in Virginia and South Carolina (fig. 1). It is anticipated that a survey will be conducted and a report submitted on the remainder of the watershed at a later date under the authority contained in the above acts.

Recommendations

It is recommended that a program of runoff and water-flow retardation and soil-erosion prevention be installed during a 20-year period in the Pee Dee River watershed at an estimated cost of $13,638,000 to the Federal Government and $7,022,000 or its equivalent [1] to local interests, making an estimated total cost of $20,660,000 for installing the recommended program.

The program will be operated and maintained at an estimated annual cost of $273,800 to the Federal Government and $844,900 or its equivalent to local interests, making an estimated total annual cost of $1,118,700 for operation and maintenance. Of the amount to be expended by local interests, $655,100 or its equivalent will be expended by farm owners and operators or corporations under agreements with soil conservation districts or other agencies of Government for maintaining conservation measures, and for operating a more profitable system of conservation farming and woodland management. The remaining $189,800 or its equivalent will be expended by a local agency or agencies acceptable to the Secretary of Agri-

[1] Labor, materials, equipment, land, easements, rights-of-way, and other contributions in lieu of cash payments.

culture for operating and maintaining those installations which are not considered a part of farm, commercial timber, or corporation operations.

The recommended program has as its objectives the reduction of floodwater and sediment damage and the conservation of soil and water resources. The interdependent measures that will accomplish these objectives are as follows: Subwatershed waterways, torrent control, gully stabilization and sediment control, erosion control along roads and railroads, terracing, field borders, farm waterways, water disposal from hill lands, woodland improvement and management, tree planting, adequate fire control, land acquisition, tributary-channel improvement and other soil and water conservation practices and measures applied in proper combination with measures listed above to complete a basic system of soil and water conservation in accordance with the needs and capabilities of the land of the watershed.

Educational assistance and technical services provided under this program will be synchronized and adapted toward the specific objectives of floodwater- and sediment-damage reductions.

The Secretary of Agriculture may make such modifications or substitutions of the measures described in this report as may be deemed advisable due to changed physical or economic conditions or improved techniques, whenever he determines that such action will be in furtherance of the objective of the recommended program.

It is estimated that the recommended program will yield an average annual flood-control benefit of $1,542,000. In addition to this flood-control benefit, an estimated average annual benefit of $9,533,000 from erosion control, conservation farming, and woodland management will accrue to private owners and operators of farm land and timber land, to railroads and highways, and to the public on lands to be acquired for watershed protection.

The ratio of the estimated average annual value of the total benefit to the average annual value of the total cost of the recommended program is 5.6 to 1.[2]

The recommended measures will be installed on non-Federal land under cooperative arrangements with individuals and with State and local governments, soil conservation districts, or other agencies acceptable to the Secretary of Agriculture.

The program herein recommended includes the intensification, acceleration, and adaptation of certain activities under current programs of the Department of Agriculture and additional measures not now regularly carried out in such programs, all of which are necessary to complete a balanced runoff and waterflow retardation and erosion-control program for the watershed. It is recommended that the Secretary of Agriculture be authorized to carry out this program. Although the current activities of the Department primarily related to the Flood Control Act are not included in the program herein specifically recommended, this program is based on the continuation of such current activities at least at their present level.

The authority of the Secretary of Agriculture to prosecute the recommended program shall be supplemental to all other authority vested in him, and nothing in this report shall be construed to limit the exer-

[2] Comparison of benefits and costs based on future price and cost levels assumed to prevail under an intermediate level of employment.

cise of powers heretofore or hereafter conferred on him by law to carry out any of the measures described herein or any other measures that are similar or related to the measures described herein.

Description of the Watershed

The Pee Dee River watershed described in this report comprises an area of 6,870 square miles, of which 6,724 square miles, or about 98 percent, are in North Carolina, 140 square miles are in Virginia, and 6 square miles are in South Carolina (fig. 1).

The Pee Dee River rises on the eastern slope of the Blue Ridge Mountains in northwestern North Carolina and discharges into the Atlantic Ocean near Georgetown, S. C. The main stem is known as the Pee Dee River below the mouth of the Uwharrie River, and as the Yadkin River above this point. The principal tributaries above Rockingham, N. C., are the Rocky, South Yadkin, and Uwharrie Rivers.

The watershed area covered in this interim report has four natural subdivisions:

1. *The mountain-foothills area*, comprising 21 percent of the watershed, is a steep and rugged section, predominantly wooded, with narrow valleys and high stream gradients. Many tributary stream banks are unstable, and channels contain much debris.
2. *The crystalline Piedmont area*, 44 percent of the watershed, is the most highly developed agricultural section of the watershed and contains the major urban and industrial centers. Sheet and gully erosion are severe and runoff is relatively rapid. Stream gradients are low, and sediment from soil erosion has caused widespread channel filling, resulting in severe flood and sediment damages to the comparatively wide bottom lands along the tributary channels.
3. *The slate area* comprises 29 percent of the watershed. Sheet erosion is severe, but the shallow soil profile prevents excessive gully development. Runoff is comparatively high, although stream channels have been little affected by sediment.
4. *The Triassic area*, containing the remaining 6 percent of the watershed, is rolling with wide swampy bottom lands. Many of the soils are heavy and plastic, and soil erosion is severe on unprotected slopes. Runoff is relatively high and channels are in poor condition.

In 1940, about 58 percent of the watershed was woodland, 25 percent was in cultivation, 5 percent was pasture, 5 percent was idle land, and 7 percent was used for miscellaneous purposes. Most of the woodland is in poor to medium condition in terms of runoff and soil stability because of fire, grazing, overcutting, improperly maintained roadways, and destructive logging. Much of the open land is seriously eroded because of poor-management practices, and pastures are commonly unimproved and overgrazed. A considerable acreage of the bottom land subject to flood overflow is used for agricultural purposes, and a much larger area has been so used at various times in the past, but has been rendered unfit for cultivation by channel filling, swamping, and overwash of infertile sediment.

The average annual precipitation, based on United States Weather Bureau records of 40- to 50-year duration, ranges from 46 inches near

Rockingham, N. C., to 49.5 inches in the extreme upper part of the watershed.

The population of the watershed in 1940 was approximately 635,000, of which about 60 percent lived in rural areas. The average density of population varied from 11 persons per square mile in the mountains to 132 persons in the crystalline Piedmont area. In 1945, farm tenancy ranged from about 10 percent in the mountain-foothills area to about 53 percent in the Triassic area. Agriculture is the principal enterprise in the watershed. Cotton, tobacco, vegetables, and fruit are the main cash crops. Timber products are produced in considerable quantity. The principal industries are textile and furniture manufacturing, and tobacco processing.

The watershed is served by excellent transportation systems of highways and railroads.

Five large privately-owned power reservoirs located on the main stream above Rockingham produce a large part of the power for industrial and municipal uses in the area.

FLOOD PROBLEMS

The size of the area, physiographic variations, and storm characteristics are such that no recorded storms have produced floods simultaneously in all parts of the Pee Dee River watershed. All of the recorded major floods have been caused by West Indian hurricane storms during the summer and early fall months. These tropical storms, characterized by excessive precipitation of erratic distribution, produce high flood peaks on the main stream and on many of the tributaries. They do the greatest damage of any individual type of flood event. The two greatest floods of record resulted from tropical storms that occurred in July 1916 and August 1940.

Floods are also caused by prolonged rains of moderate intensity, which occur at all seasons, but most frequently during winter and spring months. The volume of runoff from the largest recorded floods on the main stream from such general rains, however, was only about one-half that of the tropical storms. On the other hand, the much greater frequency of such prolonged rains makes the resulting floods the cause of a major part of the total flood damage.

Violent local storms in the mountain areas create flash floods, the force of which is dissipated before the flood flows progress very far downstream. Local damages occur to stream banks and channels and to the adjoining bottom lands. Also, prolonged rains in the Piedmont section cause overflows of longer duration on tributary streams, but these flows are often absorbed by the main stream without any appreciable rise in stage.

Destruction of growing crops is the largest item of flood damage in the watershed. Of all crop damages, approximately 89 percent occurs on the bottom lands of tributary streams and only 11 percent occurs on the flood plain of the main stem.

Except during the destructive major floods resulting from tropical hurricanes, damage to farm buildings, fences, and other improvements is of only local importance. North Wilkesboro and Elkin, N. C., are the largest towns that suffer significant urban and industrial damages. Serious damage to highways and railroads occurs mainly during major floods.

Other damages considered but not evaluated in monetary terms in this report include loss of life, illness caused by floods, personal injuries, insecurity of property and income, disruption of public services and education, and costs of relief and sanitation. The prevalence of these hazards, however, furnishes additional incentive for the program recommended in this report.

The highest rates of runoff occur on the steeper cleared uplands and in the heavily overcut and repeatedly burned woodland. Approximately 72 percent of the woodland area, which comprises 58 percent of the watershed, is classed as "poor" from the standpoint of runoff retardation. More than 20,000 acres of rapidly deteriorating open land now in crops, pasture, or standing idle are classed as critical flood runoff and sediment-producing areas. Continued widespread misuse of mountain land over a period of years has seriously upset stream regimen, resulting in heavy debris movements and damage to stream banks and channels that in a great many cases cannot be rectified by land treatment alone. Such conditions are, generally prevalent on the small tributary streams of the higher, forested portions of the mountain region. Sample surveys in the watershed have shown that individual gullies and gullied lands, which together comprise less than 2 percent of the area sampled, produced nearly 23 percent of the total volume of sediment deposited on overflow areas or carried into stream channels.

Approximately 39 percent of the bottom lands along tributaries in the crystalline Piedmont area has been damaged by modern impairment of drainage (swamping) as a result of channel filling by sand and other products of erosion. Overwash of infertile sediment, mainly sand, has damaged approximately 6 percent of the bottom lands in this section, and scouring of topsoil and channel cutting by floodwaters have affected about 5 percent of the bottomland areas. As considerable acreage has been affected by more than one of these types of damage, the above percentages are overlapping.

In the mountain-foothills area, 10 percent of the tributary bottom lands has been damaged by overwash (sanding) and 5 percent by scour. Swamping is not a problem.

In the slate and Triassic areas, the only significant damage of recent origin to bottom lands is by scour.

The annual loss of income on areas affected by damage to land varies from 35 to 66 percent as a result of overwash (sanding), 25 to 100 percent as a result of swamping, and 15 to 30 percent as a result of scour.

Except in parts of the mountain-foothills area, stream-bank erosion generally causes little or no damage along natural channels as stream banks are generally covered with a rank growth of vegetation, which is obstructing many of the channels. Newly constructed channels, however, generally must be protected against bank erosion by planting vegetation.

The majority of reservoirs in this watershed have relatively short periods of usefulness because of high rates of silting. Many smaller reservoirs already have been filled beyond their minimum required capacity. The average loss of storage capacity caused by silting in existing reservoirs is about 0.8 percent annually.

The cost of treating water used for public and industrial water supply is higher because of the suspended sediment carried by floodwaters.

Sediment damages to navigation and drainage channels, recreation, aquatic life, and public health have been recognized but were not evaluated in monetary terms in this survey.

Much of the material which is eroded from unprotected cut and fill slopes along highways and railroads is transported to the stream channels or is deposited on productive agricultural land.

The estimated average annual monetary damages in the Pee Dee River watershed are distributed as follows: Floodwater damage to crops and pastures, 66 percent; floodwater damage to urban properties and public utilities, 5 percent; reservoir sedimentation damage, 6 percent; added cost of water treatment, 13 percent; and land damage, including sanding, swamping, and scour, 10 percent.

Table 1 lists the estimated average annual monetary damages in the Pee Dee River watershed.

TABLE 1.—*Estimated average annual monetary damages in the Pee Dee River watershed*

[1946 prices]

Floodwater damages:		
Agricultural: Crop and pasture	$1, 437, 000	
Nonagricultural: Urban and public utility	116, 000	
Subtotal		$1, 553, 000
Sediment and land damages:		
Reservoir sedimentation	$142, 000	
Added water-treatment costs	277, 000	
Land damage (sanding, swamping, and scour)	221, 000	
Subtotal		640, 000
Total average annual damage		2, 193, 000

ACTIVITIES RELATED TO FLOOD CONTROL

The United States Department of Agriculture is actively cooperating with State and local agencies in carrying out programs for the conservation of soil, water, and timber resources in this watershed. The United States Forest Service administers and protects approximately 36,300 acres of national-forest land which was acquired for watershed protection and for timber production. State forestry agencies, in cooperation with the United States Forest Service, help protect private woodlands against fire, provide technical assistance to owners in proper management of their woodlands, and make trees available for reforesting open or poorly stocked forest land. The Production and Marketing Administration offers financial assistance to farmers for carrying out soil- and water-conservation practices. The Department also cooperates with State extension services and experiment stations in educational and research work in the conservation of soil and water resources. The Soil Conservation Service is currently assisting soil conservation districts in the application of soil- and water-conservation measures on farm lands. The present annual Federal cost of those portions of the Department's "going" programs which produce flood control and associated benefits is approximately $1,071,000.

Although the primary purpose of the conservation programs in the area has been the maintenance of soil resources and improvement of crop and timber yields, they have produced some flood-control benefits.

The Department of the Army, Corps of Engineers, has developed a comprehensive plan for flood control, hydroelectric-power development, and navigation on the Pee Dee River. This plan submitted to Congress in 1944 (H. Doc. 652, 78th Cong.), has been subsequently modified to the extent of recommending four flood-detention reservoirs, two on the main stem and two on Reddies River above North Wilkesboro, N. C., in lieu of the Wilkesboro multiple-purpose reservoir recommended in the comprehensive plan. The four flood-detention reservoirs were authorized in the Flood Control Act of 1946. These reservoirs are planned to protect areas of high damage along the upper Yadkin River.

The United States Department of the Interior administers 16,900 acres of national-park land on which various conservation practices are being applied.

Active soil conservation districts, organized under State laws, cover the entire watershed area. A program of soil and water conservation and land management on farm lands is being developed by the soil conservation districts, with technical assistance from the Soil Conservation Service and with the cooperation of other Federal, State, and local agencies.

Approximately 40 drainage districts, containing about 140,000 acres, have been organized under North Carolina State law in the crystalline Piedmont area of the watershed.

The States of Virginia, North Carolina, and South Carolina have done a limited amount of erosion-control work along the principal highways.

Five privately owned power reservoirs located on the main stem of the Pee Dee River above Rockingham, N. C., have contributed to the reduction of downstream flood stages as a result of drawn-down pools in anticipation of high flow during storm periods.

Recommended Program

The program of runoff and water-flow retardation and soil-erosion prevention recommended in this report was developed from a study of representative sample areas. The present condition of the sample watershed land areas and minor watercourses was considered in detail to determine the types and quantities of practices and measures that would be most effective in reducing floodwater and sediment damages. The data derived by the sampling procedure were applied to relatively similar areas to estimate total requirements of the most beneficial and practical works of improvement for runoff and water-flow retardation and soil-erosion prevention.

The recommended program will accomplish a substantial decrease in floodwater and sediment damage and an increase in the productivity of watershed lands. Practices and measures are primarily for retarding or controlling water from the time it reaches the land until the excess flows are discharged into the major streams. Some measures are most effective by increasing the absorptive capacities of the soils of the watershed, while others will be installed to conduct runoff that cannot be absorbed by the soils along the least damaging route

to the major streams. Other measures will be used to trap or screen out sediment that is not otherwise controlled. All of these measures installed in the proper combination and sequence will be necessary to provide for the most practical and effective utilization of rainfall and orderly management of runoff. Since the program of recommended measures was developed to function as a whole, each integral measure is designed to function most effectively in combination with the others.

The program is planned for completion during a period of 20 years. Works of improvement will be installed, operated, and maintained largely by the landowners, operators, and other local interests. The scheduling of Federal participation and the completion of the recommended program will be dependent upon the rate at which local cooperation develops.

The recommended program consists of the following interrelated and interdependent measures for both flood control and conservation of watershed lands that will function to conserve soil and water, accelerate infiltration, reduce runoff and increase soil fertility. The approximate number of each of these measures is shown in table 2.

Subwatershed waterways.—Large volumes of uncontrolled runoff from individual farms and groups of farms are producing excessive bank cutting and scour in secondary channels. In addition, serious damage results to bottom lands by deposition of harmful sediments. Reshaping of waterways to obtain broad watercourses of adequate capacity with low velocities of flow as well as the application or installation of protective vegetation and structural controls for stabilization will be required to reduce this flood and sediment damage. In some cases, waterways extending entirely across flood plains to the tributary stream outlets will be necessary to dispose of surplus water satisfactorily.

In the design of water-disposal systems for subwatersheds it is sometimes desirable to incorporate a small amount of floodwater storage in some of the structures in order to reduce the installation cost of other measures in the system. These small detention-type floodwater-storage measures are recommended for use in water-disposal systems as stabilizing measures in headwater areas. They will consist of small earth-fill dams with an outlet to release water at a fixed and safe rate and with auxiliary spillways adapted to site conditions. Since these installations will be small, their effectiveness will be most beneficial in reducing the installation cost of control measures immediately below the site. They will also produce additional benefits by furnishing some protection to flood plain lands and improvements.

Torrent control.—Construction of headwater channel barriers and similar devices in the channels and gullied tributaries of the mountain and foothills area will reduce sediment movement, channel scour, and bank cutting and retard flood flows. This work will be tied in with the development of good forest and other permanent cover so as to achieve maximum benefits.

Gully stabilization and sediment control.—Gullies are one of the principal sources of sediment. They extend up the slopes continually dividing into numerous gullies which progressively increase in size and area of destructiveness. Concentration of runoff afforded by the gully channels creates veritable sluiceways for the transport of ero-

sional debris to lower streams and valley lands. Active gullies are contributing largely to the deposition damage problems. The gully-treatment work will emphasize vegetative stabilization with perennials such as kudzu, Lespedeza sericea, and local shrubs. Other types of controls including gully control dams and other structural means will be utilized as needed. Drainage from overlying areas will be diverted from the gullies into stabilized waterways where practicable. The gully stabilization work is designed to decrease the volume of silt originating in active gullies, reduce the rate at which land is being destroyed by gullies, and retard the present rapid concentration of runoff. At the mouth of some of these large gullies, or at a point of concentration of a sediment producing area, it may be necessary to construct temporary earth dams for sediment control.

These will be supplemented with plantings of deep-rooted shrubby perennials or trees which will not wash out and will provide effective protection throughout the year over a long period of time. Temporary dikes and diversion ditches will be used as necessary to afford protection until the vegetative plantings are established.

Erosion control along roads and railroads.—Unprotected slopes of earth excavation and embankments for roads and railroads and along outfall ditches are major silt producing sources. In many cases, adequate water-disposal measures have not been adopted and installed and terraces often discharge directly down steep slopes of road cuts and into road ditches These conditions are conducive to extensive erosion and large volumes of sand and silt are washed downstream to fill stream channels and to spread over fertile bottom lands. Reshaping of excavation and embankment slopes and roadside ditches, vegetative plantings, and mechanical measures are essential for more orderly control and disposal of storm runoff and reduction of the volume of sediment originating along road and railroad rights-of-way.

Terracing.—Terraces will be installed to manage the runoff from sloping lands, principally those in cultivation, and to reduce soil erosion and sediment production. They will direct the surface runoff not otherwise disposed of into water-disposal systems.

Field borders.—The narrow strip of land along field borders often left idle is a source of serious erosion and presents annoying runoff problems. Field borders can be protected against these problems and improved for useful production. Vegetation of field borders will prevent woods from encroaching on the fields, provide vegetated drains where needed to carry off excess water from the ends of furrows, control erosion, and produce food, cover, protection, and other wildlife benefits.

Farm waterways.—Natural and artificial farm waterways have been severely damaged by gullying and in many cases where protective measures have been supplied they have not been properly installed and maintained. The reestablishment of existing drainageways and the installation of new waterways will be required to provide adequate means for the safe disposal of excess water from farms. Farm waterway improvements will consist largely of vegetated drainageways such as broad type meadow strips, V-shaped vegetated channels, and grassed or sodded terrace outlets. Supporting structures will be installed to implement vegetative control where necessary. The waterways for each farm will be planned and installed in accordance with natural drainage of adjacent farms so that waterways on a single

farm and those on adjacent farms operate as a unit of the drainage system for the group of farms involved. The stabilized farm waterways and outlets will reduce sediment yields and land destruction resulting from uncontrolled runoff.

WATER DISPOSAL FROM HILL LANDS

The disposal of water from hill lands without damage to fertile bottom lands is dependent on adequate channel capacity. The conversion of severely eroding hill lands to more permanent types of vegetation is closely associated with bringing bottom lands back into production. Drainage will permit a transfer of large acreages of clean tilled row crops from sloping, erodible lands to bottom lands.

Woodland improvement and management.—Aproximately 2¼ million acres of woodlands not now in Federal ownership, but including a considerable acreage recommended for public acquisition will be improved and properly managed for watershed protection. Such measures include timber marking for proper harvesting and slash disposal and protection against grazing to increase infiltration of water into the soil, to reduce soil erosion, and to increase the income from woodland products.

Tree planting.—Inadequately stocked woodland areas will be improved by partial plantings as needed on some areas and complete plantings on others. Trees will be planted on the contour and irregularly spaced, with continuity broken by staggering them. Low spots that will be formed between trees will serve to increase depression storage. Tree planting in the selected areas will increase infiltration and water-holding capacity of the soil, retard runoff, and reduce erosion on critical floodwater and sediment source areas. In addition, future timber resources will be provided.

Adequate fire control.—Approximately one-third of the watershed is now under organized fire control. The protection afforded this area, however, is inadequate. A higher degree of protection therefore is necessary. In addition, the much larger area not now receiving organized fire protection will be brought under protection. An adequate fire-protection system will be established and maintained through the use of personnel, equipment and installations including necessary buildings. By reducing the area burned over annually, the infiltration and water-holding capacities of woodland soils will be increased and sediment production decreased, and losses of timber by fire will be greatly reduced.

Land acquisition.—Public acquisition of certain normally forested mountain land now constituting critical floodwater and sediment source areas is recommended for watershed protection. Because of the poor quality of the land and the low returns derived from it, many owners of this unstable area are not interested in managing the lands for either watershed protection or timber production. Many of them have indicated a willingness to participate in the program by voluntarily selling critical lands to a public agency. Public management of these areas will assure that the various measures and practices can be installed and maintained most satisfactorily.

All of the necessary measures for stabilization of the purchased land are included in the recommended program. The purchased land will be administered as public forests. Acquisition under the recom-

mended program will be supplemented as required by additional Federal or State acquisition for watershed protection and related purposes from funds provided under other Federal or State authority.

Other conservation practices and measures.—Additional soil and water conservation practices and measures will be applied as needed for obtaining a proper combination with the mutually supporting measures listed above and to complete a basic system of soil and water conservation and proper land use in accordance with the needs and capabilities of the land of the watershed. This will include other farm and woodland practices and measures that may be required to make more effective or facilitate the installation of the above measures. This will produce the most practical, workable combination of measures that will be most efficient in providing runoff and waterflow retardation and soil-erosion prevention.

The quantities of measures included in the recommended program are based on total watershed needs less the estimated accomplishments under "going" programs over a 20-year period. The income of farm and woodland operators is expected to increase materially as the recommended program becomes progressively effective. No major changes in the acreages of cash crops are involved and it is anticipated that the principal cash crops will continue to be cotton and tobacco except in the mountains where fruits and vegetables predominate. The greatest increases in acreage will be in pasture and perennial hay crops.

Tributary channel improvement and streambank stabilization.—Channel-improvement measures consisting of clearing and removing debris, enlarging and straightening channels where necessary, and establishing suppressive and protective vegetation on the banks of the streams will be practical and beneficial. Clearing and snagging operations are recommended on both dredged and undredged tributary streams. Dredging and realinement of stream channels is recommended in the undredged areas and rehabilitation of flood channels is proposed in the dredged areas. The channel-improvement work will regulate the movement of floodwater, provide an immediate reduction in flood stages along tributary channels, and permit a more productive use of fertile flood plain land.

Educational assistance.—Landowners and operators and others in the watershed will be furnished educational assistance relative to the need for the recommended program and its purposes and objectives. Information will be supplied as to the manner in which landowners and operators now obtain services and assistance that are available through the various governmental agencies and how they can and should by their own efforts contribute successfully and most economically to the accomplishment of the over-all objectives. Intensified educational efforts will be directed to familiarizing farmers with the specific practices essential to water-flow retardation and soil-erosion prevention, how to install and apply those measures not requiring the detailed assistance of a specialized technician, how to maintain such installations and measures, and how to integrate all into the soundest farming system to produce the greatest benefit over a long period of time.

The Department is committed to a watershed and subwatershed approach in carrying out its responsibilities in the interest of flood control. It is essential that educational assistance provided under

this program be directed toward furthering the specific objectives of floodwater and sediment damage reduction and that it be fitted as to method and synchronization into subwatershed operations activities.

Technical services.—Technical services will be provided for (1) planning and applying woodland-improvement measures and management practices for watershed protection, (2) planning and applying land-use adjustments, (3) planning and applying conservation measures on the farm, and (4) integrating the installation of individual measures into a proper combination to achieve the most effective program of runoff and water-flow retardation and soil-erosion prevention. These services are required to assist the people in the watershed in installing the recommended measures on their land and in adopting the recommended practices for their farm and woodland operations.

Testing the effectiveness of the program.—The Department of Agriculture will conduct such investigation, design studies, detailed planning for program installations and evaluation of the effects of the program as may be necessary to adapt practices and measures to watershed problems for accomplishing the objectives of the program in an efficient manner.

These installations will be made on selected subwatersheds to determine the most effective methods for operating and maintaining the land-treatment program.

Cost of the Recommended Program

The estimated cost of installing the recommended program in the Pee Dee River watershed is approximately $20,660,000. Of this cost, it is estimated that the Federal Government will expend $13,638,000; non-Federal public agencies, $1,514,000; and private interests, $5,508,000. The estimate of total costs and the apportionment of costs to the Federal Government, non-Federal public agencies, and private landowners and operators are based on experience obtained in the application of practices and measures similar to those recommended in this report.

Federal participation will include educational assistance, technical services, materials, planting stock, special equipment, and other direct aids where appropriate and needed to assist in the installation and maintenance of the recommended practices and measures.

The cost and the responsibility for the installation of any phase of the recommended program that is assigned in this report to the Federal Government may be assumed by State or local governments or responsible local agencies. It is anticipated that the estimated Federal cost can be reduced as a result of a greater realization upon the part of the people of the watershed that the installation of practices and measures for the most part is economical without Federal assistance. States and other local agencies will be urged to participate in the program to the fullest extent possible so that they will bear a proportionate share of the cost commensurate with the benefits that will accrue to them.

The estimated average annual cost of operating and maintaining the recommended program is approximately $1,118,700. Of this cost, the Federal Government will expend $273,800; non-Federal public agencies, $189,800; and private interests, $655,100. The

Federal Government will provide (1) any maintenance of measures installed by it that may be required from the time of completion of such measures to the time of their transfer in good condition to the operating and maintaining agency, (2) operation and maintenance of measures installed on land to be acquired by the Federal Government, (3) one-half of the cost of maintaining adequate fire control on non-federally owned woodland, and (4) the cost of technical services necessary for maintenance of woodland improvement and management practices on privately owned woodland.

The estimated cost of installing the recommended program in the Pee Dee River watershed is shown in table 2.

TABLE 2.—*Estimated cost of installing the recommended program in the Pee Dee River watershed*

Item	Unit	Approximate number	Cost (1946 prices)
			Dollars
Subwatershed waterways	Mile	500	1,367,000
Torrent control			323,000
Gully stabilization and sediment control	Mile	2,600	1,078,000
Erosion control along roads and railroads	do	7,200	778,000
Terracing	do	23,400	1,818,000
Field borders	Acre	8,300	235,000
Farm waterways	do	14,600	987,000
Water disposal from hill lands	do	58,600	864,000
Woodland improvement and management	do	2,257,000	4,304,000
Tree planting	do	21,000	215,000
Adequate fire control	do	2,506,000	3,010,000
Land acquisition	do	160,000	2,976,000
Tributary channel improvement and stream-bank stabilization.	Mile	1,400	2,705,000
Total			20,660,000

The costs of testing effectiveness of program, technical services, and educational assistance are included in above costs. The estimated cost for technical services and educational assistance amount to approximately 16 and 2 percent, respectively, of the total cost of the recommended program. Of these amounts it is recommended that non-Federal public agencies bear one-half the cost of technical services on privately owned woodland and one-half the cost of educational assistance. While the estimates include 4 percent of the total cost for testing the effectiveness of the program, not more than 0.5 percent of such cost will be used for that purpose, unless the Secretary of Agriculture determines that the expenditure of additional funds is needed.

BENEFITS FROM THE RECOMMENDED PROGRAM

The principal benefits that will result from carrying out the recommended program are reductions in floodwater damage, reductions in sediment and land damages, increased productivity of bottom lands, and associated benefits such as open land conservation benefits, woodland benefits, and decreased maintenance costs on public roads and railroads.

BENEFITS FROM REDUCTIONS IN FLOODWATER DAMAGE

The effect of the recommended practices and measures will be to reduce significantly many small floods which, considered collectively, inundate relatively large areas frequently. The medium-sized floods

will be modified considerably, thereby further decreasing the extent and frequency of flooding. The benefit resulting from reducing floodwater damage accrues mostly to agriculture and makes up 61 percent of the estimated total average annual flood-control benefit. The major benefit to agriculture, mostly for crops and pasture, will occur on the tributary streams. Benefits will also accrue to industrial, commercial, residential, utility, highway, and railroad properties due to less damaging floods than are experienced under present conditions. The recommended program, when installed in proper combination and sequence and adequately maintained, will lower floodwater damages in the watershed by an estimated 61 percent. These benefits will begin soon after installation of the recommended practices and measures.

BENEFITS FROM REDUCTIONS IN SEDIMENT AND LAND DAMAGES

Benefits related to sediment damages occurring in the watershed are of three principal kinds; reduction in the sedimentation of reservoirs, reduction in water-treatment costs, and reduction in land damage.

Benefits accruing through decreased rates of sedimentation and consequent extension of the life of reservoirs for water supply and power purposes were evaluated for all reservoirs of importance in the Pee Dee River watershed. Reservoirs in the watershed range in size from small-channel types to the High Rock Power Reservoir with an original capacity of 290,000 acre-feet and surface area of 16,000 acres. Some reservoirs are completely filled while others are rapidly approaching the limit of their usefulness. The recommended program, if carried out, will result in appreciable benefits to 10 reservoirs. The average annual damage to reservoirs by sediment is expected to be reduced by about 51percent.

Practically all of the public water supply in the watershed comes from surface sources and is treated before use. The watershed remedial program will reduce materially the sediment content of the water and thereby decrease the annual cost of water treatment by an estimated 15 percent.

Sediment and land damages are classified as deposition of infertile materials, swamping, and scouring or washing away of the flood-plain surface. These damages will be reduced by the soil- and water-conservation practices and measures on the land and channel improvement and stabilization works which will cut down sand movement and deposition, improve drainage conditions by lowering the water table in swampy areas, and reduce high velocity overflows causing land scour. These measures are anticipated to be effective to the extent of reducing land damages by sanding, swamping, and scour by almost 78 percent.

Benefits accruing from all the reductions in sediment and land damages described above are estimated to be about 19 percent of the total average annual flood control benefit.

BENEFITS FROM INCREASED PRODUCTIVITY OF BOTTOM LANDS

The recommended channel measures and associated works of improvement for controlling runoff will not only prevent swamping damage but will provide opportunities to rehabilitate poorly drained

bottom lands subject to overflow through a reduction in flooding and by providing improved outlets that will permit better drainage of fertile bottom lands by the landowners and operators. Much of this land has a high capability for producing excellent yields of cultivated crops. Lands of lower capability when properly protected against floods and drained will produce moderate returns from hay and pasture. Approximately 64,000 acres of bottom land will be benefited from the recommended program. The benefit from this improvement comprises about 20 percent of the total average annual flood-control benefit.

ASSOCIATED BENEFITS

Other benefits evaluated in this report that will accrue from the installation of the recommended practices and measures include open land-conservation benefits, woodland benefits, and decreased maintenance costs on public roads and railroads.

The open land conservation benefits evaluated in monetary terms consist of the direct benefits that will accrue among participating landowners and operators through decreases in farm-operating costs and increases in farm income.

The woodland benefits were derived from a determination of yields with and without the recommended program. It is expected that under watershed management, the forest stands will be brought into full stocking. This will be accomplished by planting trees, providing adequate fire control, restricting the periodic cut to a portion of the annual growth until the stand is fully stocked, and other watershed woodland management practices. Comparative incomes on the basis of present conditions and conditions with a program were used to estimate the average annual benefit of the woodland measures.

Eroded material washed down from unprotected roadway and railroad cuts and fills obstructs ditches and culverts. About one-third of the total cost of roadway maintenance is chargeable to the removal of this material. Eventually some of this eroded material washes downstream, causing sediment damage to flood plains and reservoirs. Highway-maintenance figures from areas already treated indicate that roadway treatment to stabilize cuts and fills and roadway ditches reduces maintenance costs by approximately 62 percent. Maintenance operations along railroad rights-of-way also can be effectively reduced by stabilization measures for orderly disposal of storm runoff and control of erosion.

The estimated average annual monetary benefit resulting from the recommended program is shown in table 3. Construction of the four flood-detention reservoirs by the Corps of Engineers as authorized by the Flood Control Act of 1946 for flood protection on the main stem of the Pee Dee River would reduce the benefits credited to the program recommended herein by approximately $27,000 annually.

TABLE 3.—*Estimated average annual monetary benefit from the recommended program for the Pee Dee River watershed*

[1946 prices]

Reductions in floodwater damage:		
Agricultural: Crop and pasture	$934,000	
Nonagricultural: Urban and public utility	12,000	
Subtotal		$946,000
Reductions in sediment and land damages:		
Reservoir sedimentation	$72,000	
Added water-treatment costs	42,000	
Land damage (sanding, swamping, and scour)	172,000	
Subtotal		286,000
Increased productivity of bottom land		310,000
Total average annual flood-control benefit		1,542,000
Associated benefits:		
Open land-conservation benefit	$2,556,000	
Woodland benefit	6,688,000	
Decreased maintenance costs on public roads and railroads	289,000	
Subtotal		9,533,000
Total average annual benefit		11,075,000

In addition to the benefits included in the above table, other unevaluated benefits will accrue. The most important benefits of this type are the prevention of loss of life, prevention of interruptions in transportation and communications, improvement of wildlife habitat, preservation of esthetic values, and improvement of the economic and social structure of the watershed area.

COMPARISON OF BENEFITS AND COSTS

A comparison of the benefits anticipated to accrue from carrying out the recommended practices and measures with the probable costs thereof has been made by converting both benefit and cost estimates to average annual values.

Because prices will vary during the installation period, comparisons of the estimated average annual benefits and costs have been made on the basis of price and cost levels assumed to prevail under an intermediate level of employment. A 2½-percent interest rate was used to convert total Federal and non-Federal public costs to an average annual equivalent cost and a 4-percent interest rate was used to convert total private installation costs to an average annual equivalent cost. A 4-percent interest rate was used in evaluating land damages and benefits. This was done in order that there might be a clearer understanding of probable benefits that will accrue from the recommended program and probable costs to be incurred in the installation of the program.

The basis for the evaluations in determining a benefit-cost ratio of 5.6 to 1 is as follows:

Farm-product prices from an index of 233 to 150 (1910–14=100).

Forest-product prices from an index of 178 to 145 (1926=100).

Farm-production costs (not including labor) from an index of 193 to 165 (1910–14=100).

Farm-labor costs from an index of 378 to 275 (1910–14=100).

Other costs and prices from an index of 346 to 325 (1913=100).

The index listed first in each case above represents 1946 prices (index of 233=1946 prices).

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